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CONTRIBUTIONS TO GEOGRAPHY, No. I.

*On the Latitude and Longitude of Chicago, Illinois. By Lieut.
Colonel J. D. Graham, of the U. S. Corps of Topographical
Engineers.*

Chicago, Illinois, November 29th, 1858.

To the American Philosophical Society, Philadelphia.

In my letter of the 2d of April last, published at pp. 313 to 315 in Vol. 6 (No. 59) of the proceedings of the Am. Phil. Society, I stated that I was induced, in the month of January previous, to make a few observations with my sextant of $7\frac{1}{4}$ inches radius, artificial horizon of quicksilver, and chronometer, for the approximate determination of the latitude of the City Hall, or Court House of Chicago. The approximate result announced for the latitude of that point, was $41^{\circ} 53' 09\cdot7$ N.

It was derived from two nights' observations, rather hastily made, consisting in all of 19 observed double altitudes of Polaris (α Ursæ Minoris), north, and 13 observed double (circum-meridian) altitudes of β Orionis, south.

Desiring to obtain a closer approximation to the true latitude of the point in question, and having no other instruments at my command than those already described, I made, with them, on the nights of the 15th and 23d of August, and the 18th of September of the present year, the observations given below.

The stars observed on were arranged in pairs, and were selected so that one of each pair should pass the meridian to the north and the other to the south of the zenith, and at nearly equal meridian altitudes. This was done for the purpose of eliminating any small and imperceptible errors that might appertain to the sextant, either in the graduation of the limb, or circular arc—in the centering of the same—in the adjustment of the mirrors—in the collimation of the telescope, or in the refraction as affected by any peculiar state of the atmosphere, especially in cases where neither thermometer nor barometer is at hand to aid in this last correction;—and also for the purpose of eliminating any error of personal equation appertaining to the observer. The index error, as it is called, of a sextant or other reflecting instrument, can only be approximately ascertained. Any residual error in its measurement is also eliminated by the arrangement above mentioned.

The *time* stars were also selected in pairs and of very nearly the same declination—both of north declination in this latitude—and of such right ascensions that one could be observed when near the east

and the other when near the west prime vertical, with but little elapsed time between the periods of their being at nearly equal altitudes when in these respective positions.

When, owing to peculiar circumstances, these time stars could not be observed when in the prime vertical, care was taken to observe them both on the same side of it, either both when north or both when south of that plane.

This was done to secure the same eliminations of errors as are above described, and also for the elimination of the effect of any small error in the observed latitude, when it was to be used as a term in the equation for computing the time.

In some instances equal altitudes of the same star were observed east and west, or before and after passing the meridian, for computing the time. This method ensures a perfect elimination of all the errors above described in obtaining the time, provided the temperature remains nearly the same during the elapsed time between the east and west observations. If however, there be much change of temperature between these two periods, the effect upon the angular positions of the mirrors, with respect to the plane of the circular arc, may be such as to produce an appreciable error in the times of the western observations. One-half of this error would enter into the result for the time, by chronometer, of the meridian passage of the star. There is another inconvenience which sometimes attends this method of getting the time, which is, that after the observations are made east, clouds may arise before the time arrives for making those west, and thus cut them off. There is usually an elapsed time of five or six hours within which such an impediment may occur, unless the weather be settled.

It is only, therefore, when the temperature of the outward air is pretty uniform, and the weather clear and settled, that we have resorted to this method.

With these precautions a practical observer may, even with so light and portable an apparatus as a sextant of good construction, reading to ten seconds of arc by aid of the vernier, an artificial horizon of quicksilver, and a good watch or chronometer, obtain a pretty close determination of the local time, and of the latitude of a place, by a few hours' work in a single night.

The station occupied for the observations here reported, was the side walk on the north margin of Huron street, eighty (80) feet east of the middle of Wolcott street. It is also four hundred and three (403) feet south of the parallel, and two hundred and nine (209) feet west of the meridian of the observing station No. 1, near the Roman

Catholic Church, which was occupied in May, 1857, for determining the difference of longitude between this place and Quebec; for an account of which see pp. 12 to 21, and 56 to 60, of Senate (Executive) Documents No. 42, of the 35th Congress, 1st Session.

By triangulation, based, for orientation, on the true meridian line determined with the astronomical transit in May, 1857, we find that our present station, which I call Chicago observing station No. 3, is 4,059.49 feet north of the parallel, and 1,027.16 feet east of the meridian of the centre of the dome of the City Hall or Court House of Chicago, equal to $40''.11$ difference in latitude, and $13''.6$ of arc = 0.9 of a second of time, difference in longitude.*

Observations for the Latitude of Chicago.

1st. 1858, August 15th. Station No. 3.

Time stars α Andromedæ east, and α Coronæ Bo-realis west. Also, equal altitudes of α Cygni.

LATITUDE OF STATION:

2d.—Same Night.

LATITUDE OF STATION.

By 12 circum-meridian altitudes of α Aquarii, S. combined with 10 altitudes of Polaris, (α Ursæ Minoris) N., $41^{\circ} 53' 45''$.6

3d. 1858, *August 23d.*

Time stars the same as on the 15th.

LATITUDE OF STATION:

By 24 circum-meridian altitudes of α Aquilæ, S.,
combined with 18 circum-meridian altitudes of
 γ Cephei, N., $41^{\circ} 53' 47''$.3

NOTE. There was still another observing station, called Chicago observing station No. 2. As I shall have occasion hereafter to refer to its position in longitude for chronometric comparisons with other places, I may as well here mention that it is 24 feet=0''.24 north of the parallel, and 179 feet=2''.37 of arc, or 0.16 of a second of time west of the meridian of the 1st. observing station, or that of May, 1857.

4th. 1858, September 18th.

Time stars, α Andromedæ, east, and α Coronæ Bo-realis, west. Also, equal altitudes of α Pegasi.

LATITUDE OF STATION:

By 15 circum-meridian altitudes of α Aquilæ, south, combined with 26 circum-meridian altitudes of γ Cephei, north, - - - - - $41^{\circ} 53' 46''$

5th.—Same Night.

By 28 circum-meridiam altitudes of α Aquarii, and 22 circum-meridian altitudes of β Aquarii, both south, and a mean from which was taken as one quantity, combined with 18 altitudes of Polaris (α Ursæ Minoris), - - - - - $41^{\circ} 53' 45''.8$

Mean;—or latitude of station No. 3, by giving the observations on each pair of stars an equal weight, $41^{\circ} 53' 46''.3$

Reduction to the centre of the dome of the City Hall, or Court House of Chicago, - - - - $- 40''.1$

Latitude of the dome of the City Hall, or Court House of Chicago, from this series, - - - - $41^{\circ} 53' 06''.2$

Extreme difference in the 5 results - - - - $1''.7$

The result of this series gives the latitude $3''.5$ less than was reported in my letter of the 2d of April last. As they were hastily made to answer a call upon me by some of the citizens of Chicago to know the approximate latitude of the place, I do not propose to give them a weight here, but I would offer the result from the five sets of observations made in August and September as a close approximation.

I would adhere to the longitude of this position as given in my letter of April 2d, namely: $5h. 50m. 32s.08 = 87^{\circ} 38' 01''.2$ west of the meridian of Greenwich.

From these determinations, and our connections by triangulation, we obtain the positions of other stations in the city of Chicago, and as I am obliged, from peculiar circumstances, to use sometimes one and sometimes another, for the purpose of making chronometric comparisons, in order to determine the longitudes of other important places in the west, I beg leave to present them here in a tabulated form for future convenient reference. They are:—

POSITIONS IN THE CITY OF CHICAGO.	Latitude North.	Longitude West of Greenwich.	
		In Arc.	In Time.
1st. Station No. 1, the observing station of May, 1857, - - - -	41° 53' 50.3"	87° 37' 44.8"	5 50 30.99
2d. Station No. 2, in the yard of the University of Saint Mary of the Lake, - - - - -	41° 53' 50.5"	87° 37' 47.2"	5 50 31.15
3d. Chicago observing station No. 3, on the north side-wall of Huron Street, 80 feet east of the middle of Wolcott Street, - - -	41° 53' 46.3"	87° 37' 47.5"	5 50 31.2
4th. Steeple (front door) of the Roman Catholic Church of the Holy Name, on Wolcott Street, between Huron and Superior Streets, - - - - -	41° 53' 48"	87° 37' 47.7"	5 50 31.18
5th. Steeple (front door) of the Episcopal Church of St. James, on Cass Street, at the S. E. corner of Huron Street, - - - -	41° 53' 45.2"	87° 37' 43"	5 50 30.87
6th. Dome of the Chicago City Hall, or Court House, - - - - -	41° 53' 06.2"	87° 38' 01.2"	5 50 32.08
7th. The New Iron Light House, (unfinished) at the end of the North harbour-pier, - - - -	41° 53' 24.9"	87° 36' 59"	5 50 27.93
8th. Steeple of the West Market House, at the intersection of the middle of Randolph Street with the west margin of Des Plaines Street, - - - - -	41° 53' 08.4"	87° 38' 47.8"	5 50 35.19
9th. The point where stood the Flagstaff of Fort Dearborn, now destroyed to cut off a bend in Chicago River, - - - - -	41° 53' 22.9"	87° 37' 35.6"	5 50 30.87
10th. Intersection of the middle of North Clark Street, with the middle of Michigan Street; north division of the City, - - - - -	41° 53' 28.5"	87° 37' 59.1"	5 50 31.94
11th. Tall chimney of the Illinois Central Rail Road Company's Machine Shop, on the lake shore, between Twelfth and Fenimore Streets; south division of the City, - - - - -	41° 51' 50.5"	87° 37' 21.27"	5 50 29.42
12th. The old Light House, on the south bank of the Chicago river, near River Street, - - - - -	41° 53' 22.5"	87° 37' 38.77"	5 50 30.59

The foregoing table affords great convenience in enabling me to take the Chicago time, by observation, at the station nearest to the rail road depot, from whence I have to start to go to any distant place which I may wish to connect chronometrically in longitude with the

meridian of Chicago, which I consider well determined with reference to the meridian of Greenwich.

I have already thus connected nine important points between Erie, Pennsylvania, and Prairie du Chien on the Mississippi river, and determined approximately their latitudes; but I have not time, at this moment, to add them here. I will, however, offer them at a future time, and as soon as I can arrange them in a brief form. They go to show that portions of the upper Mississippi river are laid down, even on the latest and most approved maps, several miles out of place in longitude.

I wish to offer this paper, as it is, for publication in the Society's Proceedings, provided it be considered acceptable.

J. D. GRAHAM,
Member of the Society.

CONTRIBUTIONS TO GEOGRAPHY, No. 2.

On the Latitude and Longitude of four additional positions on Lake Michigan, and of MADISON, the Capital of the State of Wisconsin; from astronomical observations by Lieut. Colonel J. D. Graham, U. S. Corps of Topographical Engineers.

Chicago, Illinois, December 14th, 1858.

To the American Philosophical Society, Philadelphia.

In my letter of the 29th ultimo, I offered for the consideration of the Society, and for publication in its Proceedings, some observations on the latitude and longitude of Chicago.

I beg leave now to offer, for the same, the following observations in a brief form, made between the 20th of June and the 7th of September, 1858, for the determination of the geographical positions of the following places. Calling Chicago I, as already presented, I will enumerate the others, for convenient reference, as follows, viz:—

- II. MICHIGAN CITY, INDIANA.
- III. WAUKEGAN, ILLINCIS.
- IV. RACINE, WISCONSIN.
- V. MILWAUKEE, WISCONSIN.
- VI. MADISON, THE CAPITAL OF WISCONSIN.

The instruments used for the observations were all of a portable character, adapted to ready use at night, whenever I had occasion to halt in the course of a long journey by rail road.